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SOLUTIA

Applied Chemistry, Creative Solutions

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January 20, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Evaluation Of Spoils Disposal Alternatives
Groundwater Migration Control System
Sauget Area 2 – Operable Unit 2
Sauget, Illinois

Dear Mr. Fayoumi:

Attached are three copies of a report evaluating the alternatives for management of the spoils to be generated by the construction of the barrier system in the vicinity of Site R. This analysis of alternatives was requested by you at a meeting on December 12, 2002 at the Solutia W. G. Krummrich Plant.

We trust that the attached report provides you with the information you need. If you have any questions about the contents, please call.

Sincerely,

Solutia Inc.

Richard Williams

for Steven D. Smith
Project Coordinator

cc: Linda Tape - Husch & Eppenberger
Sandra Bron – IEPA
Peter Barrett – CH2M Hill
Richard Williams - Solutia

EVALUATION OF SPOIL DISPOSAL ALTERNATIVES

GROUNDWATER MIGRATION CONTROL SYSTEM

SAUGET AREA 2 – OPERABLE UNIT 2

SAUGET, ILLINOIS

Submitted To:

United States Environmental Protection Agency
Region V
77 West Jackson Blvd.
Chicago, Illinois

Submitted By:

Solutia Inc.
500 Monsanto Avenue
Sauget, Illinois

January 17, 2003

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1.0 Introduction

On October 3, 2002, an Administrative Order for Remedial Design and Interim Remedial Action (the Order) associated with the Sauget Area 2 groundwater operable unit (the OU) was sent to a list of potentially responsible parties (PRPs) for the Sauget Area 2 Superfund Site (the Site) by the United States Environmental Protection Agency (U.S. EPA). The Order (Docket No. V-W-'02-C-716) directed respondents to perform a remedial design for the Interim Groundwater Remedy described in the associated Statement of Work (SOW) and the Record of Decision (ROD) dated September 30, 2002, and to implement the design by performing an interim remedial action.

The Interim remedy defined in the ROD was based on the following Remedial Action Objectives (RAOs)

- Prevent or abate actual or potential exposure to nearby human populations (including workers), animals or the food chain from hazardous substances, pollutants or contaminants;
- Prevent or abate actual or potential contamination of drinking water supplies and ecosystems;
- Achieve acceptable chemical-specific contaminant levels, or range of levels, for all applicable exposure routes;
- Mitigate or abate other situations or factors that may pose threats to public health, welfare or the environment; and
- Mitigate or abate the discharge of groundwater to the Mississippi River so that the impact is "insignificant" or "acceptable".

In order to satisfy these RAOs, the remedy defined in the ROD includes:

- The installation of a 3,500 foot long "U"-shaped, jet grouted barrier wall to be installed between the downgradient boundary of Sauget Area 2 Site R and the Mississippi River;
- Institutional controls;
- Groundwater recovery wells;

- The treatment and discharge of extracted groundwater; and,
- Groundwater quality monitoring, groundwater level monitoring, and sediment and surface water monitoring.

The selected remedy is considered an interim remedial action for the groundwater OU at the Site. This action is intended to address the release of contaminated groundwater into the Mississippi River in the vicinity of the OU. The on-going RI/FS for the Sauget Area 2 Sites will investigate whether additional remedial actions are necessary.

As noted, the barrier wall will consist of a U-shaped, single panel jet grouted barrier wall that fully penetrates the granular aquifers between the downgradient boundary of Site R and the Mississippi River. The wall will be approximately 3, 500 feet long and will be constructed from the top of the granular aquifer (the Middle Hydrogeologic Unit), at a depth of approximately 40 feet, to the top of bedrock, at a depth of between 130 and 140 feet. Construction of the wall will generate spoils that will require stockpiling and/or disposal. The options for handling the spoils were briefly discussed at a meeting with the U. S. EPA and the Illinois Environmental Protection Agency (IEPA) on December 12, 2002. At that meeting, the Agencies requested that Solutia prepare and submit a report identifying and evaluating the alternatives for managing the spoils.

This document responds to that request. Alternatives considered in the evaluation include the following:

- Transport and off-site disposal in a RCRA Subtitle C (hazardous waste) facility;
- On-site treatment and subsequent off-site disposal as special waste at a RCRA Subtitle D facility; and,
- Containment in a temporary on-site stockpile covered with a high density polyethylene (HDPE) liner.

2.0 Site Background and History

The Sauget Areas 1 and 2 disposal sites are located in the City of East St. Louis and the Villages of Sauget and Cahokia, Illinois. The Sauget Area 1 sites consist of six inactive disposal areas, while the Area 2 sites consist of five similarly inactive disposal areas. These sites are located in an area historically used for heavy industry, including chemical manufacturing, metal refining, petroleum refining, power generation, and waste disposal. Five of the six Area 1 sites (sites G, H, I, L, and M) and four of the five Area 2 sites (sites O, Q (dog leg), R, and S) are located upgradient of the OU and the observed releases of groundwater to the Mississippi River. Site R is located adjacent to the Mississippi River and is the location of the proposed remedial efforts defined in the ROD. Summary descriptions of each of these sites are provided below, since they will have all contributed to the characteristics of the groundwater intercepted by the barrier system and, hence, the nature of the spoils.

2.1 Site G

This is an approximately 4.5-acre municipal and industrial waste landfill that operated from sometime after 1940 to 1960s. The landfill contains about 140,000 cu. yd. of waste. Two CERCLA removal actions were undertaken by U.S. EPA at the site. The first of these, in 1988, consisted of the construction of a perimeter fence around the landfill. The second action, which occurred in 1995, consisted of the excavation of PCB, organics, metals, and dioxin contaminated soils on and surrounding Site G, solidification of open oil pits on the site, and covering part of the site (including the excavated contaminated soils) with a clean soil cap approximately 18 to 24-inches thick. Based on testing performed during these actions, soils at the site contain a number of VOCs, SVOCs, pesticides, PCBs, dioxins, and metals..

2.2 Sites H and I

These two waste disposal areas are connected under Queeny Avenue. Site H is estimated to be 5 acres, while Site I is about 17 acres. The sites operated between 1931 and early 1960s and accepted both municipal (Site H) and industrial wastes. The current waste volume is estimated to be about 850,000 cu. yd. Site H is covered with a vegetated cap, while Site I is covered with gravel and is used as a container storage area and for truck parking. Based on historical sampling and testing, the soils on and around Site H contain a number of VOCs and SVOCs, pesticides, PCBs, and metals.

2.3 Site L

Two surface impoundments were located in this area and were used between approximately 1971 and 1981 for disposal of wash water from truck cleaning operations. The site is about one acre and is estimated to contain about 18,000 cu. yd. of material. The lagoons have been backfilled and the site is presently covered by cinders. The constituents detected in Site L soils during historical sampling and analyses included VOCs, SVOCs, PCBs, and metals.

2.4 Site M

This site was used as a sand borrow pit in the middle to late 1940s. The pit was approximately 14 feet deep and a little over one acre in area. It was hydraulically connected to Dead Creek and was estimated to contain about 3,600 cu. yd. of sediments. The sediments were removed in 2001 and disposed of in an on-site containment cell as part of a Time Critical Removal Action undertaken by Solutia. The constituents identified in the soils in the bottom of Site M were primarily SVOCs, PCBs, and metals.

2.5 Site O

During its operation, the Village of Sauget treatment plant received and treated industrial and municipal wastewater. Four lagoons were constructed at the wastewater treatment plant in 1965 and placed in operation in 1966/1967. Between 1966/67 and approximately 1978, these lagoons were used to dispose of clarifier sludge from the wastewater treatment plant. The lagoons were closed in 1980 by stabilizing the sludge with lime and covering it with approximately two feet of clean, low-permeability soil. Currently, the lagoons are covered with clean, low-permeability soil and are vegetated.

2.6 Site Q

Disposal started at Site Q in the 1950s and continued until the 1970s. This facility took various wastes including municipal waste, septic tank pumpings, drums, organic and inorganic wastes, solvents, pesticides and paint sludges. It also took plant trash, waste from other industrial facilities and demolition debris.

USEPA conducted a CERCLA removal action at the northern portion of Site Q in 1995, and a second removal action at the southern portion of Site Q beginning in October of 1999 and into early 2000. During the latter removal action, USEPA excavated over 3,200 drums and over 17,000 tons of contaminated soils containing metals, PCBs, and organics.

2.7 Site R

This landfill was operated between 1957 to 1977. Hazardous and non-hazardous bulk liquid and solid chemical wastes and drummed chemical wastes were disposed at Site R. Disposal began in the northern portion of the site and expanded southward. Wastes contained phenols, aromatic nitro compounds, aromatic amines, aromatic nitro amines, chlorinated aromatic hydrocarbons, aromatic and aliphatic carboxylic acids and condensation products of these compounds.

2.8 Site S

In the mid-1960s, solvent recovery began on the Clayton Chemical property, which is now owned by the Resource Recovery Group (RRG). The waste solvents were steam-stripped, resulting in still bottoms that were allegedly disposed of in a shallow, on-site excavation that is now designated Site S. In 1983, IEPA modified Clayton Chemical's permit to allow acceptance and distillation of spent halogenated and nonhalogenated solvents with a minimum solvent content of 30 percent.

3.0 Spoil Volume and Characteristics

3.1 Estimated Spoil Volume

The barrier wall to be built between Site R and the river will be constructed using jet-grouting techniques. Jet grouting involves injecting a grout mixture at very high pressures (up to 5,000 to 6,000 psi) and velocities as great as 1,000 feet per second into the pore spaces of the surrounding soil formation. Drilling is performed using rotary or percussion drilling techniques and an external water flush with special drill rods and bits. Following the advance of the drill rods to the design depth, the jet-grouting process commences. The jetted grout cuts, replaces, and mixes the soil with cementing material to form an impermeable soil-cement admixture. The soil structure is destroyed as grout and soil are mixed, forming a homogenous mass.

During this construction process, spoils will be generated since some of the original soil material and the pore water will be replaced with grout. Those spoils will be pumped to the ground surface in the annular space between the walls of the grout injection hole and the grout rods and are typically collected in a pit excavated in the vicinity of the injection hole. The volume and type of spoils will depend on the contractor's selected means and methods. Material from the following sources are expected to comprise the spoils:

- Spoils from the boreholes to be used for the injection pipes;
- Pore fluids present in the soil matrix (i. e., groundwater);
- Cuttings from construction of the jet grouted elements; and
- Excess or spilled grout.

Therefore, the spoils could be any combination of clay, sand, gravel, water, and grout. For the purpose of this project, it has been estimated that approximately 3 0,000 cubic yards of spoil will be generated during construction. This volume was determined based on discussions with a specialty contractor, as well as on calculation of the volume of material to be excavated from the grout pits adjacent to the injection points.. The solidified material in the pits adjacent to the barrier wall will be excavated using a backhoe, loaded into trucks and transported to the spoils containment cells.

The basis of this estimate was provided to the U. S. EPA in a letter dated January 9, 2002. The calculations forming the basis for the estimate are included as Attachment A to this report.

3.2 Spoil Characteristics

In 1998, Ecology and Environment (E&E) prepared the report "Sauget Area 2 Data Tables/Maps" for U. S. EPA Region 5. This report summarized existing data for each site, along with other information compiled by E&E during its file searches of various agencies and organizations. It contains data from investigations conducted by Clayton Environmental Consultants, Dynamac, E&E, IEPA, Geraghty and Miller, Reidel Industrial Waste Management, Russell and Axon and U. S. EPA.

The existing soil data for Site R are relatively limited and, in cases, the specific sample locations are unclear.. However, the summary showed that the soils under and around the site contained a number of VOCs, SVOCs, pesticides, PCBs, and metals. VOC concentrations in subsurface soil samples ranged from 0.15 to 5,800 mg/kg, while SVOCs ranged from 0.017 to 19,000 mg/kg. Pesticide concentrations ranged from 0.011 to 99 mg/kg. PCB concentrations in subsurface soil samples ranged from 0.075 to 4,800 mg/kg and some metals, including As, Cr, Pb, Ni and Hg, were slightly elevated in most samples.

A much more comprehensive data base is available for groundwater in the vicinity of Site R. Groundwater data collected at Site R in January and May 2000 indicate that the maximum Total VOC and SVOC concentrations at Site R are 74,600 μg/l and 6,760,000 μg/l, respectively. Total VOC concentration highs in the Shallow Hydrogeologic Unit (SHU), the Middle Hydrogeologic Unit (MHU), and the Deep Hydrogeologic Unit (DHU) are located in the northern half, northern two thirds and the extreme northern end of Site R, respectively, while the Total SVOC concentration highs are located in the central portions of Site R for all three of these hydrogeologic units.

These January and May 2000 groundwater data can be summarized in terms Total VOC and Total SVOC concentrations as follows:

	Total VOC Concentration (ppb)	Total SVOC Concentration (ppb)
Shallow Hydrogeologic Unit	74,600	6,760,000
Middle Hydrogeologic Unit	47,210	1,529,000
Deep Hydrogeologic Unit	1,950	34,800

The data collected in 2000 are summarized in Table 1, which shows the mean constituent concentrations in groundwater in each of the hydrogeologic units at the site. It should be noted that metals are not included in this table since the samples were not analyzed for metals. Since the spoils will include both subsurface soils and pore fluids, the groundwater quality can be considered to be reasonably representative of a fluid extract from the soil. On that basis, the excavated soils will likely be classified as characteristic hazardous waste if removed from the site since the concentrations of several compounds exceed the regulatory TCLP level (1,2 –dichloroethane, benzene, vinyl chloride, 1,4-dichlorobenzene, 2,4,6-trichlorophenol, and nitrobenzene).

4.0 Evaluation of Alternatives

As noted in Section 1, this document evaluates the following alternatives for management of the spoils generated during the construction of the barrier system:

- Transport and off-site disposal in a RCRA Subtitle C (hazardous waste) facility.
- On-site treatment and subsequent off-site disposal as special waste at a RCRA Subtitle D facility.
- Containment in a temporary on-site stockpile covered with a high density polyethylene (HDPE) liner.

Each of these alternatives is separately discussed below. It should be noted that the estimated cost for each of the alternatives only includes those elements that are unique to that alternative. Thus, costs that are common to all alternatives, such as collection of spoils at the individual grout injection holes and transport to a central collection facility, are not included.

4.1 Transport and Off-Site Disposal

Removal and off-site disposal of the spoils would protect public health and the environment by containing the materials in a secure disposal facility. RCRA Land Disposal Restrictions (LDRs) will determine whether or not the spoils can be land disposed without treatment. For organic constituents, treatment is presumed to be incineration although thermal desorption and solvent extraction can also be used to achieve the Universal Treatment Standards. If the constituents requiring treatment are metals, then the appropriate treatment may be different than temperature desorption. The lack of reliable data on metal concentrations in soil does not permit this evaluation. However, if the LDRs are triggered because of high metals concentrations, the treatment costs could be significant.

Because of the mixing of the spoils during the jet grouting process, it is not possible to use the existing soil characterization data to evaluate whether the spoil will contain constituents at concentrations in excess of their Universal Treatment Standard (UTS) and, thus, subject to treatment under the requirements of 40 CFR 268.48. However, given the groundwater quality around Site R, it is likely that treatment will be required since several constituents in the groundwater are present at concentrations well in excess of the wastewater standards defined in the regulations. While this comparison may not be strictly valid, it does provide some indication as to what could be expected in the subsurface soils.

Even if the LDRs are not applicable to the spoils, however, data from previous investigations indicate that PCBs may be present at concentrations as much as 4,800 mg/kg. Since the spoils contain PCBs with concentrations greater than 50 ppm, any off-site disposal facility selected to receive excavated sediments would need a TSCA permit. Solutia, by policy, transports hazardous wastes to Emelle, Alabama. Exceptions to this policy are made only for facilities where Solutia has transported wastes in the past, e.g. Model City, New York. The existing data also suggest that the spoils could contain dioxins. If present, these compounds will make off-site disposal difficult (and perhaps impossible) because RCRA and TSCA disposal facilities are typically not permitted to receive materials containing this constituent.

For cost estimating purposes, it must be assumed that all of the spoils will be hazardous because of the RCRA mixture rule and the fact that it will not be possible to segregate hazardous and non-hazardous spoils on site. Solutia currently pays between $250 and $400 per cu. yd. to transport and dispose of hazardous wastes at Emelle. The actual price depends on the waste constituents and on the extent to which individual roll-off boxes are utilized. In this case, the cost will be closer to $400 per cu. yd. because of the likely high organic concentrations . This estimate is consistent with a unit rate of $400 per cu. yd. provided to Solutia by Chemical Waste management in 1991/1992 for transport and disposal of soils from Dead Creek.

Based on these assumptions, it is estimated that the cost for transporting the 30,000 cu. yd. of spoil to Emelle, Alabama for disposal as a hazardous waste will be in the range of $10,500,000 to $15,000,000. The details of this estimate are as follows:

Transportation (550 miles one way) @ $50 per cu. yd.	$1,500,000
Disposal ($200 to $350 per cu. yd.)	$6,000,000 - $10,500,000
Traffic control, Project Management, Legal (10%)	$750,000

Contingency (25%)	$2,062,000
Total Estimated Cost (rounded)	**$10,500,000 - $15,000,000**

It is emphasized that these costs do not include any allowances for:

- Dewatering and water treatment;
- Treatment to satisfy LDRs;
- Treatment at the TSD facility to handle high VOC concentrations (e.g., micro encapsulation).

All of these, particularly treatment to satisfy LDRs, could significantly increase the actual cost.

At the meeting with the U. S. EPA and the IEPA on December 12, 2002, the possibility of transporting soils from the site to the containment cell constructed in Area 1 for sediments excavated from Dead Creek was discussed. That cell has a maximum design capacity of approximately 60,000 cu. yd. and currently holds about 45,000 cu. yd. of excavated sediment. Consequently, the available space (approximately 15,000 cu. yd.) is not sufficient for the expected volume of spoils. Moreover, some of that available space may be required for additional sediment to be excavated from the creek during implementation of the final remedy for the creek bottom soils.

It must also be recognized that if the spoils are removed from the Site limits and are taken outside of the Area of Contamination as defined in the National Contingency Plan (NCP), they will become subject to all of the RCRA disposal regulations, including the LDRs. Thus, transporting the spoils from the vicinity of Site R to the Area 1 containment cell could result in the need for treatment to satisfy the LDRs, and may not even be possible since the containment cell is not a permitted RCRA disposal facility.

Because of these issues, the option of disposing of the spoils in the Area 1 containment cell is not considered to be viable.

4.2 On-Site treatment and Off-Site Disposal

This alternative will involve the thermal treatment of the spoils and subsequent off-site disposal. The ability to treat the spoils such that they can be disposed of at a RCRA Subtitle D facility cannot be evaluated at this time. That evaluation will require extensive spoil characterization and the performance of a pilot test to determine the elements of the treatment train and the ability of that treatment train to remove the hazardous constituents to levels that will make the material suitable for disposal as a special waste.

For comparative purposes, the minimum cost of implementing this alternative is estimated to be $8,200,000. This estimate is based on the simplifying (and perhaps optimistic) assumption that thermal treatment will be able to treat the spoils sufficiently to permit their disposal as special waste, and that additional treatment, such as solvent extraction, will not be required. The details of this estimate are as follows:

Site preparation (staging area, pads, fuel storage, etc.)	Allow $250,000
Thermal treatment @ $150 per cu. yd.	$4,500,000
Disposal at $40 per cu. yd.	$1,200,000
Project management, Legal, etc. (10%)	$600,000
Contingency (25%)	$1,600,000
Total Estimated Cost (rounded)	**$8,200,000**

It is emphasized that this cost estimate is considered to be the minimum for this alternative and the actual cost will probably be considerably more. In fact, if the spoils cannot be treated to satisfy special waste standards and have to be disposed of as hazardous wastes, then the total cost of this alternative could increase to somewhere in the neighborhood of $20,000,000.

Moreover, even if this alternative proves to be cost effective, it may not be viable because of the need to satisfy the requirements of air emission permits and pilot testing. The lengthy review process typically associated with satisfying the requirements of an air emissions permit will likely preclude the use of this alternative at the site.

4.3 On-Site Stockpiling

This alternative is based on the assumption that the final disposition of the stockpiled spoils will be included in the ROD for Area 2. Given that assumption, it is proposed that the spoils be placed in a temporary stockpile on the existing landfill until the final remedy for the site is defined in the ROD.

Under this scenario, the stockpile will be designed to be secure against scour and erosion, even during extreme flooding events. The details of the design are as follows:

- The stockpile will be contained within a compacted soil perimeter berm approximately 4 feet high . The crest of the berm will be constructed at elevation 432 ft., approximately 6 ins. higher than the Corps of Engineer's levee, and approximately 3 feet higher than the 500 year flood elevation. Thus, the stockpile will not be inundated, even during the most extreme flooding events. In this context, it is noted that the top of Site R was not inundated in 1993 during the most recent extreme flooding event.

- The outer slopes of the berm will be covered with rip-rap to provide erosion and scour protection. The rip-rap will extend to the top of the berm.

- The spoils will be covered daily with a temporary synthetic cover, such as PVC. Once all of the spoils are in place, a high density polyethylene (HDPE) cover will be placed over the stockpile and this will be covered with 12 ins. of soil. The soil cover will be seeded once complete.

- During spoil placement, all storm water that comes in contact with the spoils will be collected, treated, and released on site.

In addition to these design measures, a specific contingency plan will be developed for the temporary stockpile. This plan will define contingency measures to be implemented in the event that flooding is anticipated during spoil placement, before the HDPE cover is in place (e.g., placement of a temporary soil cover on the spoil).

The estimated cost to implement this alternative is $550,000, as follows:

Compacted soil (4,500 cu. yd. @ $15 per cu. yd.)	$67,500
Cover soil (10,000 cu. yd. @ $10 per cu. yd.)	$100,000
Rip-rap (1,500 cu. yd. @ $ 30 per cu. yd.)	$45,000

Geotextile (28,500 sq. yd. @ $1.35 per sq. yd.)	$38,475
Geomembrane (28,000 sq. yd. @ $5.00 per sq. yd.)	$142,500
Project management, Legal, etc. (10%)	$40,000
Contingency (25%0	$110,000
Total Estimated Cost (rounded)	**$550,000**

5.0 Comparative Analysis

Of the three alternatives evaluated, on-site containment in a secure temporary stockpile appears to offer the most cost effective approach to managing the spoils. The proposed stockpile design provides assurance against scour and erosion during even the most extreme flood events and the spoils will be incorporated into the final remedy for Site R that is defined in the Area 2 ROD. If that final remedy does not include a new cover for Site R, alternatives for the final disposal of the stockpiled spoils can then be evaluated. In the interim, the stockpile will be protected such that it does not pose risks to the environment.

The option of transporting the spoils off-site for disposal is protective, in that the spoils will be disposed at a permitted landfill facility. However, the final cost of this alternative is very uncertain and will depend on the need to treat the spoils to achieve Universal Treatment Standards for one or more constituents. Further, this alternative presents the greatest short term risks in light of the need to transport 30,000 cu. yd. of impacted materials (1,500 truck loads) almost 600 miles.

The cost for implementing the third alternative, on-site treatment and off-site disposal, is the most uncertain of all the alternatives evaluated. Further, this alternative may not be viable because of the need to satisfy air emission permit requirements and the need for a full scale pilot test before the treatment train is finalized. Because of these uncertainties, this alternative is the least attractive of the three evaluated.

In summary, therefore, on-site containment is protective and is the most cost effective action. The other alternatives are either not feasible, or are not cost effective. It is noted that the cost of these other alternatives could be at least as much as the cost of the entire remedy, and may be much greater.

TABLE 1

TABLE 1

SITE R GROUNDWATER QUALITY

PARAMETER (a)	CONCENTRATIONS FROM GROUNDWATER		
	UHU	MHU	DHU
	MEAN CONC. ug/L	MEAN CONC. ug/L	MEAN CONC. ug/L
VOCs (ug/L)			
1,1,1-Trichloroethane	477	110	
1,1,2,2-Tetrachloroethane	717		
1,1,2-Trichloroethane			
1,1-Dichloroethane	572	132	
1,1-Dichloroethene	312	84	
1,2-Dichloroethane	1,150	465	190
1,2-Dichloropropane			
2-Butanone (Methyl Ethyl Ke	634		
2-Chloroethyl Vinyl Ether			
2-Hexanone			
4-Methyl-2-pentanone	485	982	271
Acetone	10,400	4,770	293
Acrolein			
Acrylonitrile			
Benzene	1,270	1,250	240
Bis(chloromethyl)ether			
Bromodichloromethane			
Bromoethane			
Bromoform	496		
Bromomethane			
Carbon disulfide			
Carbon tetrachloride			
Chlorobenzene	13,600	5,380	2,970
Chloroethane	1,050		
Chloroform	200	59	
Chloromethane		268	175
cis-1,3-Dichloropropene			
Dibromochlormethane			
Dichlorodifluoromethane			
Ethylbenzene		201	159
Methyl Isoamyl Ketone			
Methylene Chloride	1,720	252	158
m-Xylene		442	368
o-Xylene		443	280
Styrene			
Tetrachloroethene	437	122	105
Toluene	773	441	382
Total 1,2-Dichloroethene			
trans-1,2-Dichloroethene	583	56	
trans1,3-Dichloropropene			181
Trichlorethene	347	76	60
Trichlorofluoromethane			
Vinyl acetate			

TABLE 1

SITE R GROUNDWATER QUALITY

PARAMETER (a)	CONCENTRATIONS FROM GROUNDWATER		
	UHU	MHU	DHU
	MEAN CONC. ug/L	MEAN CONC. ug/L	MEAN CONC. ug/L
Vinyl chloride	1,760	289	
Xylenes		418	72
SVOCs (ug//L)			
1,2,4-Trichlorobenzene	6,110	1,350	110
1,2-Dichlorobenzene	6,440	2,290	2,140
1,2-Diphenylhydrazine			
1,3-Dichlorobenzene	6,040	1,330	99
1,4-Dichlorobenzene	6,270	1,570	315
2,3,7,8-Tetrachloro-dibenzo-p-di			
2,4,5-Trichlorophenol			
2,4,6-Trichlorophenol	9,410	2,540	767
2,4-Dichlorophenol	28,600	11,700	3,100
2,4-Dimethylphenol	8,750	1,800	175
2,4-Dinitrochlorobenzene			
2,4-Dinitrophenol			
2,4-Dinitrotoluene			
2,6-Dichlorophenol			
2,6-Dinitrotoluene			
2-Chloroaniline	46,100	93,800	51,100
2-Chloronaphthalene	6,070		
2-Chlorophenol	65,600	11,900	1,660
2-Methyl-4,6-dinitrophenol			
2-Methylnaphthalene			
2-Methylphenol			
2-Nitroaniline	31,200		502
2-Nitrobiphenyl			
2-Nitrochlorobenzene	164,000	39,700	52,600
2-Nitrophenol			
3,3'-Dichlorobenzidine			753
3,4-Dinitrochlorobenzene			
3-Chloroaniline	14,100	19,200	17,600
3-Methylphenol (m-Cresol)	82,800	27,600	
3-Nitroaniline			
3-Nitrochlorobenzene	95,200	90,500	6,410
4,6-Dinitro-2-methylphenol			
4-Bromophenyl-phenylether			
4-Chloro-3-methylphenol	7,760		
4-Chloraniline	24,800	39,400	22,700
4-Chlorophenol	18,800	10,400	3,180
4-Chlorophenyl-phenylether			
4-Methylphenol (p-Cresol)	11,800		
4-Nitroaniline	31,200		504
4-Nitrobiphenyl			
4-Nitrochlorobenzene	67,100	21,000	24,100
4-Nitrodiphenylamine	163		453
4-Nitrophenol	38,600	7,870	
Acenaphthene			

TABLE 1

SITE R GROUNDWATER QUALITY

PARAMETER (a)	CONCENTRATIONS FROM GROUNDWATER		
	UHU	MHU	DHU
	MEAN CONC. ug/L	MEAN CONC. ug/L	MEAN CONC. ug/L
Acenaphthylene			
Aniline	20,700	135,000	18,600
Anthracene			
Benzidine			
Benzo[a]anthracene			
Benzo[a]pyrene			125
Benzo[b]fluoranthene			
Benzo[g,h,I]perylene			
Benzo[k]fluoranthene			129
Benzoic acid	13,100		
Benzyl alchohol	403		
bis(2-Chloroethoxy)methane	6,070		
bis(2-Chloroethyl)ether			264
bis(2-chloroisopropyl)ether			264
bis(2-Ethylhexyl)phthalate	6,560	1,550	448
Butylbenzylphthalate			
Carbazole			
Chrysene		1,340	125
Dibenzo[a,h]anthracene			
Dibenzofuran			
Diethylphthalate			
Dimethylphthalate			
Di-n-butylphthalate			447
Di-n-octylphthalate			
Fluoranthene		1,330	111
Fluorene			
Hexachlorobenzene			
Hexachlorobutadiene			
Hexachlorocyclopentadiene			560
Hexachloroethane			
Indeno[1,2,3-cd]pyrene			
Isophorone			
Naphthalene	8,120	1,760	88
Nitrobenzene	6,790	2,030	196
N-Nitrosodimethylamine			
N-Nitroso-di-n-propylamine			
n-Nitrosodiphenylamine		1,330	120
Pentachlorophenol		7,950	209
Phenanthrene			
Phenol	223,000	74,900	4,110
Pyrene		1,320	98
Pyridine			
Triphenylphosphate			

ATTACHMENT A

URS CORPORATION

Sheet No. 1 Of

File 21561192.00001

Made by WDL Date 11/12/02

FOR Solutia Barrier Wall

Checked by [illegible] Date 11 13 [illegible]

Quanity of spoils from wall construction

Wall Length is 3410 ft. Panels are on 8 ft centers so, THERE are 427 panels $3410 \div 8 = 426.25 \approx 427$ panels.

Production is 3 panels per rig per shift. So, one rig would take 143 da

$427 \div 3 = 142.33$ 143 days

Volume of drill hole

3 in dia hole, 140 ft deep

$\left(\frac{3}{12}\right)^2 \pi \times 140 = 197.44$ ft³ 7.3 cy per hole

7.3 cy x 427 holes = 3203 cy for wall

Volume of panel

Wall panel varies in thickness from 4 in to 12 in So, use 8 in average.
The panel length varies from 18 to 20 ft use 20 ft worse case.
The panel height is 100 ft.

$\frac{8}{12} \times 100 \times 20 = 1340$ ft³ 49.6 cy per panel

Assume 100% spoils

49.6 cy x 427 panels = 21179.20 cy for wall

Daily Production For Land fill

3 panels + 3 holes = 3(49.6) + 3(7.3) = 171 cy per rig per shift.

Total Quanity for Land fill

3203 + 21179.20 = 24,382.00 cy 24,400 cy for wall

URS CORPORATION

Sheet No. 2 Of

File 2156/192.00001

Made by WDL Date 11/12/02

FOR Solutia Barrier Wall

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Size of Spoil Pit and Ditches for 3 panels. 171 cy per rig per shift

$171\,cy \times 27\frac{ft^3}{cy} = 3ft \times 18ft \times L$ L = 85.3 use 90 ft

Pit Freeboard

$90 \times 18 \times 3 = 4860\,ft^3$ 180 cy $100 \times 18 \times 3 = 5400\,ft^3$ 200 cy

$180 - 171 = 9\,cy$ $200 - 171 = 29\,cy$

$\frac{9\,cy \times 27}{90 \times 18}$ = 2 inch $\frac{29\,cy \times 27}{100 \times 18}$ = .435 5 inch

Volume of pit

1 pit for every 3 panels. There are 427 panels So, there are 142 pits for the wall

$142 \times 200\,cy$ = 28,400 cy for pits for wall

Volume of ditch

3 ditches for each pit. Ditches will be 2 ft by 2 ft by 10 ft.

$2 \times 2 \times 10 = 40\,ft^3$ = 1.5 cy per ditch

3 ditches × 1.5 cy = 4.5 cy per pit

4.5 cy × 142 pits = 639 cy for wall

URS CORPORATION

Sheet No. 3 Of
File 21561192.00001

Made by WDC Date 11/12/02

FOR Solutia Barrier Wall

Checked by Date

WALL AND PIT DIAGRAM